

NOTHING TO BE DONE  
Governor  
Suzanne Dandoy, M.D., M.P.H.  
Executive Director  
Kenneth L. Alkema  
Director  
288 North 1460 West  
P.O. Box 16690  
Salt Lake City, Utah 84116-0690  
(801) 538-6121

May 29, 1991

Ken A. Kluksdahl  
Tenneco Minerals  
P.O. Box 2650  
955 North 1300 West #4  
St. George, Utah 84770

Re: Response to Item No. 4 Notice of  
Violations and Order Docket No. I91-03

Dear Mr. Kluksdahl:

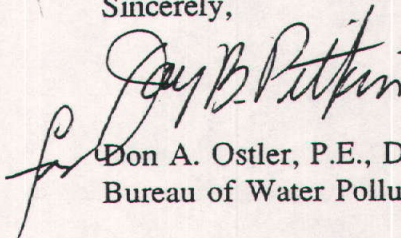
We appreciate the actions you have taken to reduce the risk of additional releases of solution during the past several months and in complying with the items listed in the referenced order.

However, Item No. 4 requests submittal of plans to conduct a ground water study to define the vertical and horizontal extent of contamination for our review. We have received results of some ground water investigations, but it does not fulfill the requirements of item No. 4 of the order.

Removal of contaminated soil under the process ponds has also not been addressed by you to this date, even though the process ponds have been upgraded.

We request that you address these two issues within two weeks of receipt of this letter. If you have any questions, or wish to discuss this issue further, please call Mr. Lyle Stott or Kiran Bhayani at 538-6146.

Sincerely,



Don A. Ostler, P.E., Director  
Bureau of Water Pollution Control

DAO:lws:rvg

cc: Mr. Wayne Thomas, Southwest Health Department

N:goldstrk.077





P.O. Box 2650  
St. George, Utah 84770

May 30, 1991

Mr. Don Ostler  
Executive Secretary  
Utah Board of Water Pollution Control  
288 North 1460 West  
Salt Lake City, Utah 84116

RE: Ground Water Investigation Plan, Tenneco Goldstrike Mine

Dear Mr. Ostler:

This letter shall serve as Tenneco Mineral Company's (Tenneco) response to Order 4. of the Bureau of Water Pollution Control's Notice of violation and Order of March 26, 1991, instructing Tenneco Minerals Company to submit for review by the Executive Secretary a plan for a ground water study to "...define the vertical and horizontal extent of contamination needed to assess corrective actions for ground water clean up".

#### Background

Ground water at the Goldstrike mine site has been studied in the past as part of the initial data package which supported Tenneco's first application for a construction permit for the Goldstrike mine. Hydrogeologic data from 22 exploration drill holes that encountered water was presented in a report entitled "Groundwater Monitoring Program Tenneco Goldstrike Project Washington County, Utah", dated August 18, 1988 and was prepared by JBR Consultants Group. This report describes, using geologic maps, cross sections, and narrative, the complex geologic setting at Goldstrike. Subsequent geologic data gathered as the result of additional exploration drilling has not significantly altered Tenneco's understanding of the local geology or hydrogeology.

Groundwater is intercepted irregularly in exploration drill holes at Goldstrike. As past work has demonstrated, water does not occur in all drill holes; in fact, most drill holes are dry. Numerous drill holes have been allowed to remain open for long periods of time



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after drilling for the purpose of monitoring water levels. Rarely has the depth of ground water in any of these holes been observed to rise to the level at which it was originally encountered during drilling of the holes. Because of the complex history of faulting in the area, there has been no observable relationship between the occurrence of water in drill holes and any single, widespread rock type or stratigraphic unit which serves as stratigraphic aquifer. Instead, hydrogeologic interpretation of cross sections and water level data from more than 30 drill holes has resulted in the conclusion that the entire fractured and faulted bedrock complex represents the water table aquifer in the mine area. These data have enabled the preparation of a potentiometric surface map of the local water table. This map, which was included in the August, 1988 report, shows a westward ground water gradient which is generally sub-parallel to the local topography. The gradient is locally south-trending in a small area east of Hamburg Peak. This occurrence is coincident with Quail Canyon and results from an apparent groundwater divide coincident with the ridge northeast of Hamburg Peak.

Tenneco and its consultants have considered the possibility of perched water tables in the area, but find that although locally isolated and high-elevation occurrences are found, the available data demonstrate that such conditions exist only under very localized conditions.

As the result of the controlled release of low-concentration cyanide solutions and the fly rock damage to the liners of the process water and barren solution ponds, two potential means of solution release to ground water exist. The most probable pathway is the release of cyanide-bearing solutions following the controlled releases of relatively weak cyanide solutions from the process water pond on March 4 and March 5, 1991. The released solutions were discharged to the unnamed canyon below and west of the process water pond area. Flow from this release moved downstream with storm runoff and was collected in the sediment pond located downstream. The capacity of the sediment pond was never reached by the runoff because the dam functioned as designed, trapping sediment and allowing the slow release of water through the relatively porous dam material. During the period of time that water flowed in the stream channel, both the sediment pond and the stream channel served as potential pathways for solutions to reach ground water.

The release of solutions from either the process water or barren solution ponds has not been demonstrated. In fact, the investigation performed by Tenneco Minerals Company of the clay liner in the barren solution pond has demonstrated that solutions did not penetrate the clay liner and that no liner samples had concentrations of cyanide which



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exceed 5 parts per million. The process water pond clay liner has not yet been investigated<sup>1</sup>; however, its liner was constructed in the same manner as was the liner in the barren pond and the solution in the process water pond was neutralized to approximately 1 part per million at the time of the fly rock incident. Therefore, the likelihood that the process or barren solution ponds represent a potential source of solution release to groundwater is very low. Nevertheless, Tenneco Minerals Company has included the ponds as potential release sites for the purpose of the proposed ground water investigation.

### Investigation Plan

In the context of the foregoing discussion and the mine site's hydrogeologic setting as described in the August, 1988 report, the investigation plan described below is proposed. In the interest of expeditiously addressing a potential environmental concern, Tenneco Minerals Company has initiated the proposed plan of investigation. All of the wells proposed for the investigation have been drilled and completed as monitoring wells. The selection of screened intervals for each well has been determined in conjunction with Mr. Mac Croft of the Bureau staff or in line with criteria mutually agreed to by him. Neutron logs were run on each well to identify water-bearing horizons. Screens were set at the interval or intervals from which water was detected either during drilling, logging, or completion. In cases where groundwater was encountered relatively high in the drill hole, the hole was advanced to its projected completion depth to determine if additional zones bearing water existed at depth. In such cases, if no water was encountered in the lower section of the hole, the hole was plugged back to a depth just below the water occurrence and screened across the water bearing zone. These completion criteria were established in conjunction with Mr. Croft.

Although, the locations of most of the wells have been established in conjunction with Mr. Croft, Tenneco Minerals Company recognizes that initiation of the investigation plan prior to receipt of the Bureau's formal approval has been done at its own risk. At the same time, Tenneco believes that timely initiation of the investigation was prudent. Tenneco's consultants have reviewed the well locations that have been decided upon by Tenneco and

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<sup>1</sup>A separate document describing the results of a planned investigation of the process pond clay liner will be submitted to the Bureau prior to the initiation of construction of the proposed process pond expansion.



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Mr. Croft and concur with the appropriateness of the well locations; thereby providing an independent assessment of the program prior to its completion.

A total of 8 new monitor wells are proposed for the required investigation. The locations of each well are shown on the attached map. Three wells, designated wells 9101, 9102, and 9103, have been sited immediately adjacent to the solution pond area and have been designed to detect shallow groundwater contamination in the event that perched water horizons may exist or pulses of recharge water, either resulting from natural causes or leakage, may move through the subsurface immediately down-gradient of the pad area. Each well has been fitted with end-capped blank casing below the screened interval to enable the capture of any groundwater that may move through the area episodically. One of these wells, number 9102, encountered water at a depth of 58 feet and should serve as a close-in monitor well for the solution ponds.

Table 1. Basic Completion Information for Proposed Ground Water Investigation Wells

Well Number	Total Depth	Screened Interval(s)
9101	54 feet	34-44 feet
9102	66 feet	46-56 feet
9103	80 feet	38-58 feet
9104	500 feet	22-42 feet
		83-93 feet
9105	385 feet	40-60 feet
9106	500 feet	330-380 feet
9107	300 feet	216-266 feet
9108	700 feet	110-140 feet



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Five other monitor wells have been sited, as shown on the monitor well location map. Four of the wells, designated 9104, 9105, 9107, and 9108, are located west of and down-gradient from the existing process facilities. One of the wells, number 9106, is located south of the existing process facilities area and is also down-gradient from the process facilities owing to the local groundwater divide located coincident with the ridge northeast of Hamburg Peak. Three of the western area wells, 9105, 9107, and 9108, have been drilled down gradient from the sediment pond site. Well 9107 is sited immediately down-gradient from the sediment pond. Well 9108 is located generally down gradient from the sediment pond and was drilled and completed at the site of an exploration drill hole which was known to have substantial standing water. Well 9105 is the farthest down-gradient well and was drilled at the confluence of Arsenic Gulch and the East Fork of Beaver Dam Wash.

The basic completion information for each of these wells is also shown on Table 1. The general criteria and conditions for completion of each of these wells are as follows:

- 1) Each well, with the exception of the three shallow wells, has been advanced either until ground water was encountered, to a total depth of 500 feet, or to a depth such that the elevation of its total depth was in excess of the elevation of the water occurrence encountered in well 9105 drilled at the confluence of Arsenic Gulch and East Fork Beaver Dam Wash. Because this well is located farthest down gradient of all of the monitor wells, the water level in this well represents the lowest possible local water table elevation in the mine area.
- 2) Each well was first drilled to its projected completion depth. Wells that encountered shallow water occurrences and no water at greater depth were backfilled to a point below the observed water occurrence and completed as shallow monitor wells.
- 3) Intervals were selected for screening based upon observations made during drilling with regard to observed occurrence of water in the wells. In most cases a single completion interval was selected. However, in the case of well 9104, drilled immediately below and west of the process pond site, two vertically separated water occurrences were observed and a dual completion was made. Separate casings and screens isolate what appears to be a local perched horizon at a relatively shallow depth and a deeper horizon apparently coincident with the local ground water table. Subsequent to cementing the casing above the lower water occurrence in well 9104, water was observed to be standing on top of the grout. A separate completion was performed to enable monitoring of this horizon. Subsequent to completion of the



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well, measured static water levels in each completion interval have maintained a separation of nearly 40 feet (Table 1), demonstrating that a local perched zone has been encountered.

In addition to the wells drilled as part of this effort, the existing down-gradient monitor well, DG-1, provides another monitoring point down-gradient from the various process components. The location of DG-1 is also shown on the attached maps.

Tenneco Minerals Company proposes to monitor these wells monthly. It is proposed that the wells will be monitored for total, weak acid dissociable, and free cyanide as well as the following analytical parameters:

Alkalinity	Iron
Arsenic	Lead
Barium	Magnesium
Bicarbonate	Manganese
Cadmium	Mercury
Calcium	Selenium
Carbonate	Silver
Chloride	Sodium
Chromium	Sulfate
Conductivity	Total Dissolved Solids
Copper	Zinc
Fluoride	
Hardness	
pH	

Many of the wells drilled in the area have been observed to recharge very slowly. Rarely can more than a single well volume be recovered during a single sampling episode. Often a full month is required for water level recovery in the existing monitor wells UG-1 and DG-1. Therefore, Tenneco proposes to dispense with the accepted sampling practice of recovering three well volumes from each well prior to recovering a water quality sample. Instead, samples will be recovered from the first bailer of water recovered from each well. Then, following this initial sample recovery, an attempt will be made at each well to recover three well volumes. In the event that this is possible, a second sample will be taken and the initial sample will be discarded.

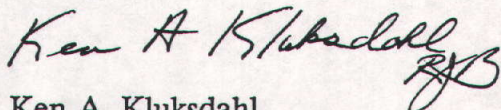


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Sampling of the wells has commenced and initial analytical results are expected in the near future. Sampling will be conducted weekly for the first month of sampling and monthly thereafter. Tenneco Minerals Company will also propose that some or all of these wells be part of its normal groundwater monitoring program. The mine monitoring program will be proposed in the forthcoming revised application for a Ground Water Discharge Permit which will be submitted in the near future. Tenneco will submit to the Bureau on a quarterly basis, the results of the analyses from samples collected in all monitor wells that encountered water. In the event that cyanide concentrations equal to or greater than 0.2 mg/l total cyanide are encountered in any of the wells, the results will be communicated to the Bureau by telecopier within one business day of confirmation of the analysis.

Should you have any questions with regard to this proposed investigation plan, please direct them to the undersigned.

Sincerely,



Ken A. Kluksdahl  
Mine Manager

Attachment: Monitor Well Location Map

cc: D. Brannum/ Tenneco Minerals Company  
M. Keller/ Vancott, Bagley Cornwall and McCarthy  
JBR Consultants Group